Water Management

Health Objectives for the Year 2010: Prevent public exposure to waterborne chemical and biological agents that are known to cause death, disease, and reduction in quality of life.

Health Implications

We must have water to live, thus we must either protect out water from contamination or spend considerable resources in an attempt to make it safe for our use. This section addresses several topic areas that all impact public health through the use and association with water.

Safe Water

Safe uncontaminated water is of utmost importance to the health of every person. Numerous disease-causing organisms and chemical contaminants can be transmitted via water and can have serious health effects. These contaminants may enter the water at the source, during transmission, and at the point of use.

To better protect the public health, in 1974 Congress passed the Safe Drinking Water Act, which has been revised many times over the years. This law requires the Environmental Protection Agency to determine safe levels of chemicals in drinking water that do or may cause health problems. These nonenforceable levels, based solely on possible health risks and exposure, are called Maximum Contaminant Level Goals (MCLG). Based on MCLGs, the EPA sets an enforceable standard called a Maximum Contaminant Level (MCL). MCLs are set as close to the MCLGs as possible, taking into consideration the ability of public water systems to detect and remove contaminants using suitable treatment technologies.[1]

Standards have been set for 80 contaminants that may occur in drinking water and pose a risk to human health. These 80 contaminants can be divided into two groups, according to whether the health effects they cause are acute or chronic. Acute health effects occur within hours or days of the time that a person consumes a contaminant. Although almost every contaminant could have an acute effect if consumed at extraordinarily high levels in drinking water, the contaminants are most likely to cause acute effects are microorganisms (bacteria, protozoa, and viruses). Most people's bodies can fight off these microbial contaminants, and exposure to them typically does not have permanent effects. Nonetheless, they can make people ill, and can be dangerous or deadly for a person whose immune system is already weak due to HIV/AIDS, chemotherapy, steroid use, or another reason.

Table 1. Water Management Indicators

	Lancaster Recent	Lancaster Objective 2010	Nebraska Recent	Nebraska Objective 2010	National Recent	National Objective
Number of violations of Safe Drinking Water Act (SDWA) by Lincoln Water System (annual)[1]	0.0[2]	Maint.	--	--	--	--
Number of violation of SDWA by other public water suppliers	34.0[3]	0.0	87.0[3]	--	--	--
Level of trihalomethanes (ppb)	29.2[4]	Maint. <40.0	--	<60.0[5]	--	<60.0[5]
Percent of citizens informed about contaminants in their public water supplies	--[6]	100.0	--	--	--	--
Percent of people able to identify common contaminant in public water supplies, health impact and how to reduce exposure	--[6]	50.0	--	--	--	--
Percent of buildings/structures with backflow protection between public water supplies and their users	--[7]	100.0	--	--	--	--
Percent of buildings/structures with backflow protection between building water system and internal potential contaminate sources.	--[7]	95.0	--	--	--	--
Percent of people able to identify common contaminant in private well water, health impact and how to reduce exposure	--[6]	100.0	--	--	--	--
Percent of private well water users testing annually for bacteria and nitrate levels	--[8]	50.0	--	--	--	--
Number of waterborne illness outbreaks from community water supplies	0.0[9]	0.0	--	--	--	2/year[10]
Proportionate growth rate between city and county	9:1[11]	Maint.	--	--	--	--
Percent of newly constructed onsite sewage treatment systems inspected and approved	95.0[12]	100.0	--	--	--	--
Percent of construction areas which meet building code requirements for storm water run off protection	--[13]	100.0	--[13]	--	--	--

Maint.=Maintain attainment

Chronic health effects can occur after people consume a contaminant, even at low levels above EPA's MCL safety standards, for many years. The drinking water contaminants that can have chronic health effects are chemicals (such as solvents, pesticides, and disinfection by-products), radionuclides (such as radium), and minerals (such as arsenic). Examples of the chronic health effects of drinking water contaminants, including disinfectant by-products (DBPs), are cancer, liver or kidney problems, birth defects, and reproductive difficulties.[2]

Land Use Planning

City growth affects multiple aspects of public health from public violence and vehicular accidents to infrastructure challenges. Unplanned growth in flood plains places citizens in physical danger during storm events, while increased population density county-wide increases demand for all community resources, including water.

Sewage Treatment

Exposure to raw or inadequately treated sewage results in many types of disease. Bacterial, protozoan, and viral diseases are directly transmitted through exposure to human waste, and indirect exposure can result when incomplete treatment returns pathogens to the environment. Poisoning may also result when inorganic wastes are returned to the environment (for example, heavy metals such as mercury, cadmium, and lead).

Sewage disposal systems can cause nitrate-nitrogen contamination of groundwater, which can cause a condition known as methemoglobinemia in infants who are fed the water.

Storm Water Management

Development of land previously used for agricultural purposes into urban/domestic and industrial property increases sediment loads and can have drastic effects on surface waters and the entire watershed. The construction process itself may degrade surface water and increase disease-causing organic and inorganic pollutants. An increased density of people and structures in previously undeveloped areas increases pollutant discharge during storm events, exposing the public to disease, or may simply exceed the storm water system's capacity, resulting in flood.

Recreational Water Usages

Contamination of surface waters exposes the people who use them, for every sort of recreational purpose imaginable, to a variety of hazards. High turbidity and sedimentation of area lakes increases the chance of drowning for people who swim, boat, and fish. Occasional high levels of coliform bacteria or parasites increase the risk of infections. Consumption of fish from water that has become contaminated with pesticides, organic chemicals or heavy metals can lead to acute and chronic health consequences.

Recreational use of swimming pools and spas exposes the user to these same categories of contamination. Biological contamination can occur from either the other bathers or due to incorrect levels of chemical sanitizer. High turbidity due to poor water chemistry and exposure to chemicals due to excessive use can create drowning risks. Both natural and human-constructed recreational waters have been shown to be the source for outbreaks of disease.

Current Status and Trends

The Safe Drinking Water Act Amendments (SDWA) of 1996 required the Center for Disease Control and EPA to work together to determine the occurrence (incidence) of waterborne disease in the United States. Other than monitoring passive surveillance systems, such research had never been done. Several studies are now underway to better define the percentage of gastroenteritis that is caused by water.[3] Another result of the 1996 amendments was the requirement for water suppliers to give their customers information on the quality of the water they provide. This information includes the source of the water, contaminants tested for and found, the health risks posed, compliance with regulations, and contact numbers for more information.[4] The Lincoln Water System (LWS) sent an annual report out in 1998 and 1999 including all required information. The LWS provides water for approximately 90% of the population in Lancaster County. The most current peak water usage figure provided by the Lincoln Water System is 75 million gallons per day, with an average production of 35 million gallons per day (167 gallons per day per person).

Disease Outbreaks – National Data

Despite the regulations adopted under the SDWA, the most recent report of waterborne disease outbreaks from CDC (covering 1995–96) reveals that 13 states reported a total of 22 outbreaks associated with drinking water, ten of which were associated with community water supplies.[5] Microorganisms such as Cryptosporidium, Giardia, E. coli 0157:H7, Shigella, and many viruses have each been implicated in serious waterborne disease outbreaks.

In 1994, an outbreak of Cryptosporidium in Milwaukee, Wisconsin, caused approximately 400,000 illnesses and 4,000 hospitalizations. The source of water for Milwaukee is surface water, which is typically much more contaminated and requires more treatment than groundwater. Another outbreak, which occurred in the late summer of 1999 in New York State, involved groundwater serving a well at a county fair. The well became contaminated with cattle manure containing E. coli 0157:H7. This second outbreak led to more than 1,000 illnesses, dozens of hospitalizations, and at least two deaths.

Disease Outbreaks – Lancaster County

More than 90% of the people residing in Lancaster County drink groundwater that is regulated under the Federal and Nebraska SDWA, including all residents of Lincoln, Hickman, Waverly, and all villages; all persons receiving water through Lancaster County Rural Water District (RWD) No. 1 and Cass County RWD No. 2; and all other residents who use "community" water supplies, such as subdivisions with a shared water system.[6] Most Lincoln and Lancaster County residents drink tap water that meets all existing health standards all the time. There has not been a confirmed outbreak of waterborne illness from a community water supply in Lancaster County in the past ten years.

For those persons relying on private wells for their drinking water, contamination with bacteria and nitrates are of highest concern. Local inspections of rural properties changing ownership have frequently found groundwater contaminated with fecal coliform bacteria and nitrate levels above what is the EPA MCL for public water supplies (10 mg/l). A study conducted in the U.S. Upper Midwest in 1994 found that 41.3% of wells sampled were contaminated with Coliform bacteria, 11.1% had E. coli specifically, and 13.4% had a nitrate-nitrogen level that exceeded the

EPA MCL.[7] In addition, private wells are not fluoridated, thus increasing the risk of dental caries for young children before they enter school and are afforded the opportunity to use fluoride-rinse programs. The Lower Platte South Natural Resources District is currently conducting a study of nitrate contamination in the Waverly area. Water quality in Lancaster County is highly variable, and many private well owners treat their water for what is referred to as "secondary" contaminants, such as iron, manganese, chloride, and hardness. These secondary contaminants do not pose health risks for most people, but may lead to unsatisfactory tastes, smells, staining of clothing or fixtures, buildups in pipes and plumbing fixtures, or loose stools.

Wellhead Protection

Natural Resources Districts (NRD's) are pivotal in groundwater management and protection of the watersheds. Groundwater Management Areas are a primary issue in this county due to a lack of abundant and good quality groundwater.[8] Groundwater management plans have been developed and implemented by the NRD's to protect this natural resource.

A wellhead protection area is the geographic area from which a well draws groundwater. This is the area where contamination can be prevented. Between 1993 and 1996, LLCHD worked with each village in Lancaster County, Lancaster County RWD No.1, and several other public water supplies (for large subdivisions, schools, and institutions) to calculate by the computer model the area each well will receive water from over the next 20 years. From this information, volunteers and LLCHD staff conducted surveys to identify potential sources of contamination of wellhead areas. LLCHD assisted teachers at each of the four rural high schools to develop a curricula and field activities for students. The students then performed water sampling and provided education to farmers, business owners, and acreage owners in the Wellhead Protection Area. Signs were erected along county roads identifying each Wellhead Protection Area. Students have also participated in "Find a Well" days, in which they go to each property within a given area to identify any wells that should be decommissioned (abandoned).[9]

Disinfection By-Products

More than 83% of Lancaster County's 240,000 people consume water that has been disinfected. Because of the large population exposed to DBPs, health risks associated with these chemicals, even if small, need to be taken seriously. Fortunately, Lincoln's water contains only low levels of the types of DBPs primarily trihalomethanes that are not generally associated with health risks.[10]

While disinfectants are effective in controlling many microorganisms, they react with natural organic and inorganic matter in source water and distribution systems to form potentially harmful DBPs. Many of these DBPs have been shown to cause cancer and reproductive and developmental (birth) effects in laboratory animals.[11] In addition, recent epidemiological, studies of human populations exposed to higher levels of DBPs have found increased risks of birth defects, spontaneous abortion (miscarriage), and low birth weights, and cancer.[12]

Land Use Planning

Land use planning has risen to the top of the public agenda. Considerable interest has been generated by development near Wilderness Park. A conference was recently sponsored by the University of Nebraska concerning productive land use for Lincoln in the twenty-first century. This conference concerned itself with sustainable development, mixed-use planning, and

economic benefits for developers, the construction industry, and property owners. New developments are reviewed by various city and county agencies for water, sewer, and storm water issues.

Sewage Treatment

Disposal is no longer an acceptable method for dealing with raw sewage. We know that nothing buried stays buried forever. Definitive treatment, which breaks the sewage down into its natural elements and returns those elements safely to the environment, is preferred. Treatment facilities for the City of Lincoln, Hickman, Waverly, the county's villages, larger businesses, and subdivisions must meet the stringent guidelines of the National Pollutant Discharge Elimination System (NPDES). Individual homes in the remainder of the county must rely upon various types and sizes of onsite sewage treatment systems. All domestic sewage treatment systems installed must be permitted and inspected.

Storm Water Management

Developers have been responsive to recommendations for no net rise in flood plain construction projects. Better methods of preventing runoff from construction sites have been developed, and the use of sediment fences and ponds are common. New regulations are proposed than will require permits for disturbing more that two acres of land and best management practices.

Recreational Water Usages

In 1995 and 1996, CDC identified 37 disease outbreaks in 17 states attributed to recreational water, including lakes, pools, and hot tubs.[13] Locally, in the summer of 1999, a childcare facility had an outbreak of E. coli 0157:H7 associated with a small wading pool and a fecal accident. Two were hospitalized, one child with hemolytic uremic syndrome.

In 1995, Lincoln experienced an outbreak of Cryptosporidium at a local swimming pool, which affected more than twenty people. Swimming pools and public spas in Lincoln are permitted and routinely inspected.

Occasionally, cases of Giardia are linked to swimming in local bodies of water. Warnings have been issued concerning the likelihood of bacterial, protozoan, and safety hazards associated with swimming in local lakes.

Work with the local minority population has identified high consumption of fish from local waters. With information available from the Nebraska Game and Parks Commission, an advisory was prepared for area lakes and streams with information indicating which fish might be contaminated and should not be relied upon as a regular food source.

Health Disparities

In general, racial and ethnic minorities are not faced with health disparities posed by water or sewage in Lancaster County. However, in 1996, the LLCHD completed an Environmental Health Hazard Risks survey in the minority community in Lincoln. One of the surprising findings was that contaminated water ranked the highest of all environmental hazard concerns. These minority Lincoln residents receive the same water as all Lincoln residents. Interactions within the minority communities led to staff concluding that either lack of trust in the government's ability to protect their health and/or lack of understanding how city water is treated lent significantly to this concern.

Perhaps the greatest disparity are the increased health risks posed to the Asian

population by significantly higher consumption of fish and reliance on fishing from local water bodies.

The perceptions of different cultures and ethnicities, in Lancaster County can affect every aspect of their water usage. In relation to pure water, one person may like the taste of well water while others prefer no taste at all in their water. It has also been observed that recent arrivals often have concerns about government credibility concerning the community water system and its safety.

Public Health Infrastructure

- Create and maintain a testing program and a data system that will allow monitoring of health indicators, such as the percentage of well–test results that do not meet SDWA limits.
- Update ordinances and policies.
- Develop and regularly conduct a public behavior and belief survey of environmental health indicators.

Recommendations

- Delineate the groundwater resources in Lancaster County by charting known aquifers and domestic wells.
- Geo-locate all domestic wells in Lancaster County.
- Continue a permitting and inspection program for newly constructed onsite sewage treatment systems.
- Permit installers of onsite sewage treatment systems and provide an educational program concerning proper installation methods and regulations.
- Continue a permitting and inspection program for newly constructed wells within Lincoln's three-mile limit.
- Promote efficient water usage as determined by LWS.
- Provide Pollution Prevention technical assistance to businesses, farms, and acreage owners in Wellhead Protection Areas.
- Educate the public that relies on private water wells of the importance of testing their water annually for bacteria and nitrates.
- Promote efficient chemical usage in city and rural situations.
- Involve water issues with land-use management planning.
- Support back-flow prevention and protection activities.
- Provide outreach to the community throuth education of youth, minorities, and professionals concerning the protection of water resources.
- Promote the best management practices to reduce the potential for contamination and soil sediment from reaching streams.
- Encourage the establishment of riparian set-asides and easements along streams and drainages.
- Encourage regular water quality testing for private drinking water supplies.
- Make information available tor recent arrivals to the city or county that outlines information about water quality.

Notes

Related indicators or discussion are located in the chapters on *Oral Health*, *Waste Management*, *Toxic and Hazardous Materials*, and *Safe Food*.

Table 1

-- Currently no data source.

1. Lincoln Water System provides water for over 90% of Lancaster County's population.
2. Lincoln Water System, 1999 (no violations).
3. LLCHD tabulations of 1999 violations data provided by Nebraska Health and Human Services System, Environmental Health Services Section, Drinking Water Program.
4. Lincoln Water System, trihalomethane levels in 1999, in parts per billion (ppb). Trihalomethanes are the most common disinfectant by-product produced by Lincoln Water System disinfection methods.
5. Safe Drinking Water Act limits set for the year 2002, in parts per billion (ppb). SDWA goals and limits are likely to change over the decade.
6. Currently no data source – data could be obtained through a community survey tool. Common contaminants would include nitrates, lead, arsenic, bacteria, and other pollutants of concern and listed in the Safe Drinking Water Act.
7. Currently no data source – however data is likely obtainable in the future from Lincoln's Building and Safety Department and the Mayor's Backflow Prevention Program.
8. Currently no data source – however data may be obtainable though a community survey or well survey project.
9. Lincoln–Lancaster County Health Department. Water and Communicable Disease Programs. No waterborne illnesses occurred in 1999, although there have been outbreaks in recent years.
10. U.S. Department of Health and Human Services, Office of Public Health and Science, *Healthy People 2010 Objectives: Draft for Public Comment*, September 1998. Healthy People Year 2010 Objective.
11. Lincoln–Lancaster County Planning Department.
12. Lincoln–Lancaster County Health Department, Water Program. Percent of newly built water systems permitted each year which were originally built with a permit rather than discovered and permitted post-construction.
13. Currently no data source – data may be obtainable from natural resources districts.

Narrative Sources

1. Drinking Water and Health, National Primary Drinking Water Regulations, Contaminant Specific Fact Sheets for Consumers, December 1998. <www.epa.gov/OGWDW/dwhcvoc/tetrachl.html> 10/11/99.
2. US EPA, Office of Water, Office of Ground Water and Drinking Water, <www.epa.gov/safewater/dwh/health.html> 10/22/99.
3. EPA, Office of Water, Office of Ground Water and Drinking Water, <www.epa.gov/ogwdw000/standard/wborne.html>
4. *The Aquifer, Journal of the Groundwater Foundation* vol. 14, no. 2, September 1990, pp. 40.
5. MMWR Surveillance Summaries, vol. 47(SS-5), December 11, 1998, pp. 1–34.
6. Lincoln City–Lancaster County Comprehensive Plan, Lincoln–Lancaster County Planning Department, 1994.
7. A Survey of the Quality of Water Drawn from Domestic Wells in Nine Midwestern States, Centers for Disease Control and Prevention, and the National Center for Environmental Health, <www.cdc.gov/nceh/programs/emergency WaterWell/WellSummary> 10/99.
8. LPS GWMP.
9. Contaminant Source Inventory Report, Wellhead Protection Program, Lincoln–Lancaster County Health Department, Lincoln, NE, December 1993.
10. Lincoln Water System, Consumer Confidence Report, 1999.
11. Microbial and Disinfection By-product Rules, US EPA, Office of Water EPA 815-F-98-0014, December 1998.
12. P. Magnus, et al.," Water Chlorination and Birth Defects", *Epidemiology*, vol. 10, no. 5, September 1999, pp. 513–17.
13. MMWR Surveillance Summaries, vol. 47 (SS-5), December 11, 1998, pp. 1–34.